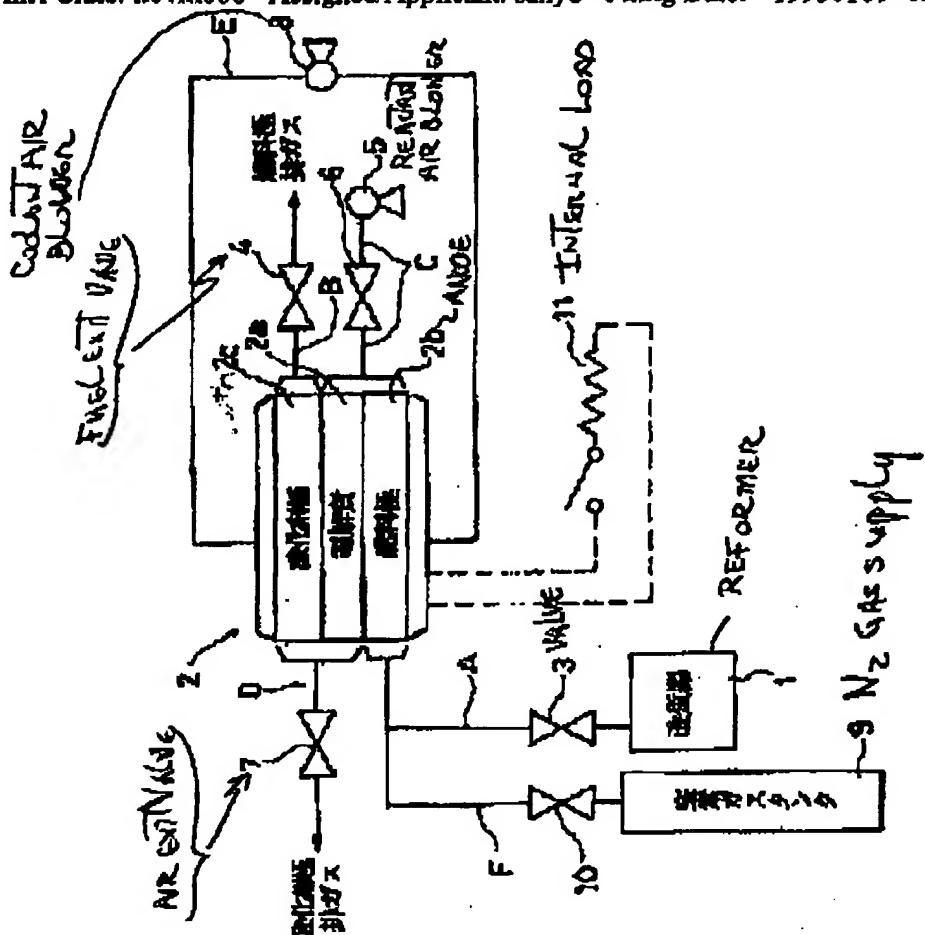


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**METHOD FOR STOPPING FUEL CELL**  
SANYO ELECTRIC CO., LTD.

SANTO ELECTRIC CO LTD  
Inventor(s): TAJIMA OSAMU ; HAMADA AKIRA ; TATEYAMA EIJI ; NAKATO  
KAZUO ; KITAMURA KENJI

KUNIHIRO; HIRUMI; KENICHI  
Application No. 05118572 IP05118572 JP Filed 19930520 A1 Published 19941202

**Abstract:** PURPOSE: To prevent the reduction in catalytic performance without causing the performance deterioration of a part of cells by stopping air supply in the state where hydrogen is supplied to connect a cell with an internal load, interrupting the internal load at a point of time when the voltage is lowered to a prescribed voltage, and stopping hydrogen supply.

**CONSTITUTION:** When operation is stopped, the interruption with an external load is conducted, a reaction air supplying valve 6 is closed to stop the supply of a reaction air. Immediately just after it, the switch of an internal load 11 is ON. Thus, the oxygen in the air left in an oxidizing agent electrode 2c is consumed, and the voltage is lowered. The load 11 is released every about 1 minute, and the open circuit voltage is measured. When the voltage is raised to 0.8V/cel or more, the load 11 is again fed, and when the voltage per average cell is lowered to 0.8V/cel, the switch of the load 11 is OFF, and an oxidizing agent electrode exhaust gas valve 7 is closed to seal the oxidizing agent electrode 2c. A reformer 1 is successively stopped, a hydrogen supplying valve 3 is closed, and a nitrogen supplying valve 10 is opened to stop the cell.

Int'l Class: H01M00804;

Legal Status: There is no Legal Status information available for this patent.

**Patents Citing This One (1):**

→ US6025083A1 20000215 Siemens Westinghouse Power Corporation  
Fuel cell generator energy dissipator



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#### DETAILED DESCRIPTION

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##### [Detailed Description of the Invention]

###### [0001]

[Industrial Application] This invention relates to the halt approach in detail about the fuel cell which generates electricity by the chemical reaction of the hydrogen and oxygen which are supplied.

###### [0002]

[Description of the Prior Art] A fuel cell is a kind of a new power plant. The structure makes the hydrogen which reforms fuels, such as natural gas, and is obtained, and the oxygen in air react electrochemically, carries out direct conversion, and, so to speak, can also call a chemistry generation of electrical energy. Since this fuel cell generation of electrical energy can use effectively the chemical energy which a fuel has and has an environment-friendly property, it was expected as an energy supply system of the city mold which will bear the 21st century, and ED has got into stride towards utilization.

[0003] By the way, in case operation of a fuel cell which was described above is stopped, after cutoff with an external load, cell temperature serves as about 180-210 degrees C, and, as for the condition of the cell immediately after stopping hydrogen and supply of air, an electrical potential difference serves as about 1.0 V/cell. If the high electrical potential difference of 0.8 or more V/cell is built over the interior of a cell in the state of such an elevated temperature, the problem of causing the fall of catalyst ability will arise by the corrosion of the carbon of the catalyst bed prepared in the oxidizing agent pole side in a fuel cell, the dissolution of a noble-metals particle, condensation, etc.

[0004] In order to solve the above-mentioned trouble, the following approaches were used from the former and a halt of a cell was performed.

\*\* How to suspend supply of air and fuel gas, supply nitrogen to two electrodes, and discharge air and fuel gas compulsorily out of a cell, when cutoff with an external load is performed. It is the approach of preventing the chemical reaction of hydrogen and oxygen occurring by discharging air and fuel gas from two poles by this approach, and making it the electrical potential difference at the time of a halt not turn to 0.8 or more V/cell by this.

[0005] \*\* It is the approach (it indicates to JP,58-32903,A public relations) of leaving it until a cell becomes low temperature (about 140 degrees C or less), and intercepting an internal load, suspending air and supply of fuel gas, connecting the internal load of a low load, and taking a load, when cutoff with an external load is performed. This approach

solves the above-mentioned problem by having lowered the temperature of a cell, even if an electrical potential difference becomes 0.8 or more V/cell after cutoff with an internal load.

[0006]

[Problem(s) to be Solved by the Invention] However, although the fall of the catalyst ability caused by carbon corrosion and it can be prevented if a fuel cell is stopped as mentioned above, the respectively following new problems arise.

\*\* In order to prevent the fall of the trouble catalyst ability of an approach and to perform air and forced discharge of fuel gas, when a lot of nitrogen gas supplies a lot of nitrogen required, produce the problem that electrolytic scattering takes place.

[0007] \*\* In fact, every time the fuel gas supplied in the trouble usual stack of an approach is supplied to each stack at homogeneity, don't break it, but a bias is in distribution. As mentioned above, even if it stops fuel gas, when a load continues being taken with an internal load, distribution of fuel gas may lapse into the condition that fuel gas ran short by the bad cell, the partial polarity inversion of a cell may occur, and degradation may occur in some cells.

[0008] This invention aims at offering the halt approach of a fuel cell that the fall of catalyst ability can be prevented, without causing the performance degradation of some cells, without using a lot of nitrogen in view of the above-mentioned trouble.

[0009]

[Means for Solving the Problem] In the halt approach of a fuel cell of this invention generating electricity by the chemical reaction of the hydrogen in the fuel gas supplied, and the oxygen in air in order to attain the above-mentioned purpose, and consuming the generated power with an external load The first step over which performs cutoff with an external load, suspends supply of the air by the side of the oxidizer pole which is not sealed where fuel gas is supplied to a fuel electrode side, and an internal load is covered, and when cell voltage falls to a predetermined electrical potential difference Supply of hydrogen is suspended, and it intercepts with an internal load, and is characterized by performing the second step which seals an oxidizer pole.

[0010]

[Function] The following operations are acquired by constituting as mentioned above.

\*\* In the first step of operation place \*\* to the corrosion of carbon, and this invention, the oxygen in an oxidizer pole is consumed by connecting a stop and an internal load in supply of air, with hydrogen supplied.

[0011] Generally the partial pressure and oxidizer pole potential of oxygen in an oxidizer become like the following formulas.

[0012]

[Equation 1]

[0013] In proportion to the change in the oxygen density in an oxidizer pole, the change in oxidizer pole potential also takes place so that clearly from one above. The fall of cell voltage takes place as the electrical potential difference at the time of an open circuit is equivalent to oxidizer pole potential and consumption of the oxygen in an oxidizer pole progresses. However, as described above, even if it performs oxygen consumption, while the oxygen density of an oxidizer pole is high, oxidizer pole potential will be high and the electrical potential difference at the time of an open circuit will turn into an electrical potential difference to which corrosion takes place. For this reason, in order to prevent carbon corrosion, it is necessary to reduce the oxygen density of the oxidizer pole at the time of an open circuit to predetermined concentration from which cell voltage does not turn into a corrosion electrical potential difference at the temperature at that time. However, since it is difficult, supervising the oxygen density of an oxidizer pole directly supervises using cell voltage.

[0014] Therefore, at the second step, since cell voltage is reduced so that an oxygen density may turn into predetermined concentration, even if the temperature in the cell at the time of a cell halt is high by cutting an internal load and stopping supply of hydrogen gas at the time of an open circuit, cell voltage does not turn into an electrical potential difference to which corrosion takes place, and corrosion is prevented.

In operation this invention to the problem of \*\* \*\*, since it is stopping without supplying nitrogen for prevention of a fall of catalyst ability as shown in the above-mentioned configuration, the problem about nitrogen is solved like before.

[0015] In operation this invention to the problem of \*\* \*\*, since fuel gas continues being supplied during connection with an internal load on the fuel gas pole so that it may be shown in the above-mentioned configuration, the partial cell performance degradation by lack of a fuel which was described above is not generated.

[0016]

[Example] The reforming machine 1 which drawing 1 is the outline block diagram of the fuel cell system concerning one example of this invention, and carries out steam reforming of the material gas, such as natural gas, and generates hydrogen-rich gas. The hydrogen-rich gas which is the structure where mixed electrolyte 2a and fuel electrode (negative electrode) 2b and oxidizer pole (positive electrode) 2c have been arranged to both sides, and was generated with said reforming vessel 1. While being prepared in the middle of the path A which connects the body 2 of a fuel cell which generates electricity by making the oxygen in air react electrochemically, this body 2 of a fuel cell, and said reforming machine 1, and this path A Supply of the hydrogen-rich gas to fuel electrode 2b of said body 2 of a fuel cell, and the hydrogen supply bulb 3 which performs a halt. The fuel electrode exhaust gas bulb 4 prepared while being the path B through which the exhaust gas discharged from fuel electrode 2b passes, and this path B, While preparing in the middle of the path C which connects the reaction air blower 5 which supplies reaction air to the oxidizing agent pole of said body 2 of a fuel cell, this reaction air blower 5, and said body 2 of a fuel cell, and this path C The reaction air supply bulb 6 which performs supply of reaction air, and a halt to said oxidizing agent pole 2c. The oxidizer pole exhaust gas bulb 7 prepared while being the path D through which the exhaust gas discharged from oxidizer pole 2c passes, and this path D. The cooling air blower 8 which ventilates cooling air in order to cool the body 2 of a fuel cell which becomes an elevated temperature at the time of operation. The path E which connects the body 2 of a fuel cell

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with this cooling air blower 8, and the nitrogen gas holder 9 which is the source of supply of the nitrogen gas purged by fuel electrode 2b. While being prepared in the middle of the path F which connects the nitrogen gas holder 9 and the body 2 of a fuel cell, and this path F it connects with the nitrogen supply bulb 10 which carries out adjustable [ of the amount of the nitrogen gas supplied to a fuel electrode 2 J, and the body 2 of a fuel cell, and has the internal load 11 which consumes the generated output of the body 2 of a fuel cell by switching on if needed.

[0017] In addition, the temperature at the time of operation is about 200 degrees C, and the temperature immediately after shutdown of the above-mentioned body 2 of a fuel cell is the same as that of an operating temperature. It explains to below, referring to Table 1 shown below about halt actuation of the fuel cell system constituted as mentioned above.

[0018]

[Table 1]

[0019] first, hydrogen and air be supply to the body 2 of a fuel cell in the condition that connect the body 2 of a fuel cell with the external load illustrate, and a hydrogen supply bulb 3, a reaction air supply bulb 6, a fuel electrode exhaust gas bulb 4, and an oxidizing agent pole exhaust gas bulb 7 open the condition of the above-mentioned fuel system under operation, a nitrogen supply bulb 10 be close and the circuit of an internal load 11 be in the condition that a switch be off ( see during table 1 operation ).

[0020] In suspending operation, first, from the condition of having described above, cutoff, with the external load which is not illustrated is performed, the reaction air supply bulb 6 is shut, and it stops supply of reaction air (refer to table 1 halt actuation \*\*). After this, immediately, the switch of the internal load 11 is turned ON and the circuit of an internal load is closed (refer to table 1 halt actuation \*\*). The oxygen in the air which remained to oxidizer pole 2c is consumed by this, and an electrical potential difference falls by it. At this time, the oxidizing agent pole exhaust gas bulb 7 is in the open condition. The oxidizing agent pole exhaust gas bulb 7 is closed at this time, and if oxygen is consumed in oxidizing agent pole 2c where oxidizing agent pole 2c is sealed, the reduced pressure in oxidizing agent pole 2c will start. If such reduced pressure takes place, the problem that air will invade and the oxygen which it is going to consume will be supplied will start from the exterior.

[0021] From immediately after internal load 11 connection, this actuation is repeated and is performed until the average electrical potential difference of a single cel stops becoming 0.8 or more V/cell if the internal load 11 is removed for every minute [ about ], open-circuit voltage is measured and an electrical potential difference rises to 0.8 or more V/cell, even if it performs the reclosing of the internal load 11 at that time and removes the internal load 11. By the above-mentioned actuation, if the electrical potential difference per average single cel falls to 0.8 V/cell, the switch of the internal load 11 will be turned OFF, it will intercept with the body 2 of a fuel cell, the oxidizing agent pole exhaust gas bulb 7 will be closed, and oxidizing agent pole 2c will be sealed (refer to table 1 halt actuation \*\*).

[0022] Then, the reforming machine 1 is suspended, the hydrogen supply bulb 3 is closed, the nitrogen supply bulb 10 is opened, the nitrogen to fuel electrode 2b is supplied, and the hydrogen which remains in fuel electrode 2b is discharged compulsorily (refer to table 1 halt actuation \*\*). Finally, the cooling air blower 8 stops, the nitrogen supply bulb 10 and the fuel electrode exhaust gas bulb 4 are closed, and actuation of a half of a cell is completed (refer to table 1 halt actuation \*\*).

[0023] In addition, let the internal load used in the above-mentioned example be what has a load lighter than an external load. As mentioned above, although the condition in the cell at the time of a cell halt is an elevated temperature by performing halt processing, an electrical potential difference becomes lower than 0.8 V/cell, and the bad influence which it has on the cell engine performance can be prevented.

(Other matters)

\*\* What is necessary is just to supply the minimum fuel gas which can operate in the above-mentioned example as an amount of the fuel gas supplied to a fuel electrode side after intercepting with an external load.

\*\* In the above-mentioned example, even if it changes the electrical potential difference of criteria as 0.8 V/cell with operating temperature (temperature at the time of a halt) in the range which does not influence the performance degradation of a cell in this reference voltage, don't interfere.

[0024]

[Effect of the Invention] the time of consumption of the oxygen in the air of an oxidizer pole being performed, and an electrical potential difference falling to a predetermined electrical potential difference by intercepting with an external load, hydrogen's being in the supplied condition, suspending supply of air, and connecting with an internal load, as explained above -- the connection with an internal load -- as -- hydrogen supply -- stopping -- things -- it is -- a cell -- a halt is performed.

[0025] Therefore, since a fuel cell can be stopped and fuel gas is supplied to this and coincidence during connection between a fuel cell and an internal load, without performing nitrogen supply for catalyst ability fall prevention by performing the approach of this invention, the polarity inversion by fuel gas lack is not caused. And since the cell temperature at the time of an open circuit can make cell voltage low also at an elevated temperature, the fall of the catalyst ability caused by the corrosion of carbon etc. can be prevented.

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#### CLAIMS

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[Claim(s)]

[Claim 1] Where it performed cutoff with an external load and fuel gas is supplied to a fuel electrode side in the halt approach of a fuel cell of generating electricity by the chemical reaction of the hydrogen in the fuel gas supplied, and the oxygen in air, and consuming the generated power with an external load The halt approach of the fuel cell characterized by performing the second step which suspends supply of the air by the side of the oxidizer pole which is not sealed, suspends supply of hydrogen, intercepts with an internal load when cell voltage falls to a predetermined electrical potential difference, the first step over which an internal load is covered, and, and seals an oxidizer pole.

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#### PRIOR ART

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[Description of the Prior Art] A fuel cell is a kind of a new power plant. The structure makes the hydrogen which reforms fuels, such as natural gas, and is obtained, and the oxygen in air react electrochemically, carries out direct conversion, and, so to speak, can also call a chemistry generation of electrical energy. Since this fuel cell generation of electrical energy can use effectively the chemical energy which a fuel has and has an environment-friendly property, it was expected as an energy supply system of the city mold which will bear the 21st century, and ED has got into stride towards utilization. (0003) By the way, in case operation of a fuel cell which was described above is stopped,

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after cutoff with an external load, cell temperature serves as about 180-210 degrees C, and, as for the condition of the cell immediately after stopping hydrogen and supply of air, an electrical potential difference serves as about 1.0 V/cell. If the high electrical potential difference of 0.8 or more V/cell is built over the interior of a cell in the state of such an elevated temperature, the problem of causing the fall of catalyst ability will arise by the corrosion of the carbon of the catalyst bed prepared in the oxidizing agent pole side in a fuel cell, the dissolution of a noble-metals particle, condensation, etc.

[0004] In order to solve the above-mentioned trouble, the following approaches were used from the former and a halt of a cell was performed.

\*\* How to suspend supply of air and fuel gas, supply nitrogen to two electrodes, and discharge air and fuel gas compulsorily out of a cell, when cutoff with an external load is performed. It is the approach of preventing the chemical reaction of hydrogen and oxygen occurring by discharging air and fuel gas from two poles by this approach, and making it the electrical potential difference at the time of a halt not turn to 0.8 or more V/cell by this.

[0005] \*\* It is the approach (it indicates to JP,58-32903,A public relations) of leaving it until a cell becomes low temperature (about 140 degrees C or less), and intercepting an internal load, suspending air and supply of fuel gas, connecting the internal load of a low load, and taking a load, when cutoff with an external load is performed. This approach solves the above-mentioned problem by having lowered the temperature of a cell, even if an electrical potential difference becomes 0.8 or more V/cell after cutoff with an internal load.

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#### TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, although the fall of the catalyst ability caused by carbon corrosion and it can be prevented if a fuel cell is stopped as mentioned above, the respectively following new problems arise.

\*\* In order to prevent the fall of the trouble catalyst ability of an approach and to perform air and forced discharge of fuel gas, when a lot of nitrogen gas supplies a lot of nitrogen required, produce the problem that electrolytic scattering takes place.

[0007] \*\* In fact, every time the fuel gas supplied in the trouble usual stack of an approach is supplied to each stack at homogeneity, don't break it, but a bias is in

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distribution. As mentioned above, even if it stops fuel gas, when a load continues being taken with an internal load, distribution of fuel gas may lapse into the condition that fuel gas ran short by the bad cell, the partial polarity inversion of a cell may occur, and degradation may occur in some cells.

[0008] This invention aims at offering the halt approach of a fuel cell that the fall of catalyst ability can be prevented, without causing the performance degradation of some cells, without using a lot of nitrogen in view of the above-mentioned trouble.

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## OPERATION

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[Function] The following operations are acquired by constituting as mentioned above.  
\*\* In the first step of operation place \*\* to the corrosion of carbon, and this invention, the oxygen in an oxidizer pole is consumed by connecting a stop and an internal load in supply of air, with hydrogen supplied.

[0011] Generally the partial pressure and oxidizer pole potential of oxygen in an oxidizer become like the following formulas.

[0012]

[Equation 1]

[0013] In proportion to the change in the oxygen density in an oxidizer pole, the change in oxidizer pole potential also takes place so that clearly from one above. The fall of cell voltage takes place as the electrical potential difference at the time of an open circuit is equivalent to oxidizer pole potential and consumption of the oxygen in an oxidizer pole progresses. However, as described above, even if it performs oxygen consumption, while the oxygen density of an oxidizer pole is high, oxidizer pole potential will be high and the electrical potential difference at the time of an open circuit will turn into an electrical

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potential difference to which corrosion takes place. For this reason, in order to prevent carbon corrosion, it is necessary to reduce the oxygen density of the oxidizer pole at the time of an open circuit to predetermined concentration from which cell voltage does not turn into a corrosion electrical potential difference at the temperature at that time. However, since it is difficult, supervising the oxygen density of an oxidizer pole directly supervises using cell voltage.

[0014] Therefore, at the second step, since cell voltage is reduced so that an oxygen density may turn into predetermined concentration, even if the temperature in the cell at the time of a cell halt is high by cutting an internal load and stopping supply of hydrogen gas at the time of an open circuit, cell voltage does not turn into an electrical potential difference to which corrosion takes place, and corrosion is prevented.

In operation this invention to the problem of \*\* \*\*, since it is stopping without supplying nitrogen for prevention of a fall of catalyst ability as shown in the above-mentioned configuration, the problem about nitrogen is solved like before.

[0015] In operation this invention to the problem of \*\* \*\*, since fuel gas continues being supplied during connection with an internal load on the fuel gas pole so that it may be shown in the above-mentioned configuration, the partial cell performance degradation by lack of a fuel which was described above is not generated.

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#### DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is a fuel cell structure-of-a-system Fig. concerning an example of this invention.

[Description of Notations]

- 1 Reforming Machine
- 2 Body of Fuel Cell
- 3 Hydrogen Supply Bulb
- 4 Fuel Electrode Exhaust Gas Bulb
- 6 Reaction Air Supply Bulb
- 7 Oxidizing Agent Pole Exhaust Gas Bulb
- 11 Internal Resistance